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3D Imaging of Microbial Processes in Subsurface Environments

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Subsurface microbial processes in aqueous heterogeneous saturated porous systems have been studied experimentally using a novel fluorescent microscopic imaging (FMI) technique. The approach involves 3D visualization and quantification of microbial distributions within a refractive index-matched transparent porous column. By staining bacteria and illuminating the porous regions within the column with a planar sheet of laser beam, microbial transport processes through the porous medium can be observed and measured microscopically. A computer controlled CCD camera is used to record the fluorescent images at every vertical plane location while sweeping back and forth across the column. These images are then digitized and accumulated over a 3D volume within the porous column.

The approach provides a unique dynamic probe to observe microbial processes as a function of local pore-scale characteristics. These results are extremely valuable in in-situ bioremediation problems since microscopic particle-contaminant-bacterium interactions are the key to understanding and optimization of these processes.

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